



## A COMPARATIVE EVALUATION OF ACCURACY OF IMPLANT IMPRESSION TECHNIQUES USING ADVANCED TRAY DESIGNS - AN IN VITRO STUDY

### Dental Science

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### ABSTRACT

**Statement of problem:** Various implant impression trays and techniques have been introduced. Some impression trays are claimed to be more accurate than others. For a precise fit of multiple implant framework, having an accurate definitive cast is imperative. **Purpose:** The purpose of this study was to compare and evaluate the accuracy of direct implant transfer impression made in stock tray, custom tray and advanced stock trays (Mira tray and Kohler tray). **Methods:** A reference model with clear acrylic resin of a mandible was fabricated and two implant analogs were placed in the tooth region of 33 and 43. Ten impressions of reference model with polyvinyl silaxane were made for each group; stock impression tray, custom impression tray, self-perforating tray (Mira tray) and Kohler tray. A reference bar (metal) was screwed and retained on the implant and the marginal discrepancy between the reference bar and abutment was measured with a travelling microscope at 3 points (buccal, distal and lingual). One way ANOVA and Post Hoc Tukey's were used for statistical analysis ( $p \leq 0.05$ ). **Results:** In the present study there was statistically significant difference between marginal discrepancy of impressions made using custom tray, stock, Mira tray and Kohler tray. Impression made using custom tray showed least marginal discrepancy followed by stock tray, Kohler tray and Mira tray respectively. **Conclusion:** Within the limitations of present study pick up impression techniques for the transfer of implants with custom tray was more accurate than with stock tray, and advanced trays (Mira Tray & Kohler tray) at determined measurement points.

### KEYWORDS

Mira tray, Kohler tray, Advanced stock tray, Marginal discrepancy, Direct implant transfer impression.

### INTRODUCTION

Success in oral rehabilitation is dependent, in part, on the accurate registration of those structures that constitute the basis for prosthesis support. Reproducing the intraoral relationship of implants through impression procedures is the first step in achieving an accurate, passively fitting prosthesis.<sup>1</sup>

Two types of impression are made for implants: Implant level impression and abutment level impression. Implant level impressions provide simplicity during restorative phase, allows selecting the proper abutment in the laboratory and it is possible to prepare adjustable or custom-made abutments. These are the advantages of implant level impressions when compared with abutment level impressions.<sup>1,2</sup>

Implant level impressions can be either direct or indirect impression. The indirect transfer (Closed tray technique) requires fastening a one-piece transfer coping to the implant and making the impression. Upon completion of set, the impression is removed from the mouth, leaving the transfer coping fastened in place. It is removed and attached to an appropriate analog, then positioned into its respective impression space. In indirect transfer impression technique there is always a chance of error due to improper positioning of transfer coping in impression. The direct technique (Open tray technique) uses square copings and an open tray, allowing the coronal ends of impression coping screw to be exposed. Before removing the impression, the copings screws are unscrewed to be removed along with the impression. The implant analogs in the impression are connected to the copings to fabricate the definitive cast. In some studies comparing direct and indirect methods for dimensional stability of cast models, direct method was found to be more accurate.<sup>3,4</sup>

The direct transfer technique (open tray) requires the use of custom impression tray. Perforation of tray in the region of the implant facilitates the insertion of transfer coping fixation screw. If the opening is narrow, then it is difficult to position the impression tray while the impression is being made; in contrast, if the opening is wide, then there is excessive overflow of the impression material and the tray is weakened. A further drawback is that the fit and/or connection between

the impression post and positioned impression tray may no longer be seen in its position relative to the impression tray. To achieve a more precise, faster, and easier impression of several dental implants, a new advance impression tray was developed which has a patented foil technology with a 15µm thick plastic polyamide film on the occlusal surface capable of being perforated by the impression transfer screws when they are positioned. This tray is known as Mira implant impression tray.<sup>5,6</sup>

Recently, the implant impression metal stock tray known as Kohler tray, for taking open tray implant impressions using the window tray technique was introduced. This metal stock impression tray has removable sections in the occlusal part to facilitate open tray (pick up) implant impressions.<sup>7</sup> therefore, metal impressions trays offer greater rigidity and support for dental impression material when compared to plastic stock tray. Kohler implant tray with removable segments is rigid reusable and can be sterilized.<sup>7</sup>

The present in vitro study was undertaken to compare and evaluate the accuracy of direct impressions made with stock tray, custom tray and advanced stock trays (Mira tray and Kohler Tray).

### MATERIALS AND METHOD

A clear acrylic resin edentulous model of mandibular arch was fabricated for the study. Two implant analogues were placed in the region of 33 and 43 of the acrylic resin model. A reference bar was used to verify the accuracy of casts produced from impressions. Four experimental groups were created with stock tray, spaced custom tray, Mira tray and Kohler tray. For each group, ten impressions were made.

**Group I** – Impression made with stock impression tray.

**Group II** – Impression made with custom tray.

**Group III** – Impression made with Mira implant impression tray.

**Group IV** – Impression made with Kohler implant impression tray

The perforated metal trays used for edentulous impressions were obtained from the manufacturer. All sample impressions were made with single tray. Two holes (5mm) were prepared in stock tray in positions with respect to implant analogs. An elastomeric impression

material was used to make impression with stock tray.

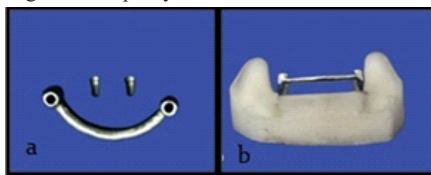
Fabrication of custom trays: Alginate impression of the master model was made in stock tray and cast was prepared. Two layers of wax spacer (3mm) were adapted over the cast fabricated from the impression and 10 custom trays were fabricated on it with tray material. Two holes (5mm) were prepared in custom trays in positions with respect to implant analogs. PVS impression material was used to make impression with custom tray.

The Mira implant impression tray simplifies the process of making open tray implant impressions. The occlusal surface is covered by a transparent plastic film. Retention slots and an internal rim provide mechanical retention to retain the impression material within the tray. Tray adhesive was not applied to the plastic film surface as this may obscure visualization of the transfer copings while inserting the tray to proper depth. PVS impression material was used to make impression with Mira tray.

The Kohler implant impression tray simplifies the process of making open tray implant impressions. Kohler tray was placed and positioned with respect to the implant analog and were marked and the corresponding section from the impression tray were removed with the driver that was supplied with the tray and impression was made. Adhesive was not applied to the impression tray as tray design built had perforations and undercuts. Therefore, the impression material was secured to the tray through mechanical retention. The Kohler tray was filled with soft putty (PVS) and light body (PVS) was injected around transfer copings and on ridge and impression was made. Seat the tray on model. After the setting of impression material, transfer copings were unscrewed and the impression was removed with transfer copings in one snap.

Implant analogs were screwed to transfer copings in impressions. Casts were poured with ADA type IV gypsum product (Die stone) as per manufacturer's instructions. After setting of die stone, transfer copings were unscrewed from implant analogs and casts with implant analogs were retrieved. All casts were stored at room temperature for a minimum of 24 hours before measurements were made.

Accuracy of casts produced by different impression techniques was measured using the reference bar. Abutments were placed on implant analogs on the cast. Reference bar was seated on these abutments. One end of reference bar was screwed with the abutment and measurements were made on the other end. Vertical gap between abutment and bar was measured at the three points (Buccal, Lingual and Distal) of the non screwed end using the travelling microscope. Measurement of the screwed end was then performed after unscrewing it and screwing the other end in a similar manner. All casts were measured in the same manner. Mean of all 6 readings for each cast was calculated to give the vertical marginal discrepancy.



Reference bar and master model used in the study



Measurement of marginal discrepancy using travelling microscope

**RESULTS**

The results and statistical analysis of the study are summarized in table 1-2. On subjecting the mean marginal discrepancy values to on one way analysis of variance (ANOVA), there was significant difference between marginal discrepancy of reference bar on the casts produced by impressions made using different impression trays. (P≤0.05). (table 1)

Table 2 shows summary of Hoc Tukey's analysis for pair wise

comparison of marginal discrepancy of casts produced by implant impression using different impression trays. Marginal discrepancy of Group II (custom tray) < Group I(stock impression tray) ≈ Group IV(Kohler implant impression tray) < Group III (Kohler implant impression tray) (P≤0.05)(table-2)

**Table 1: Descriptive statistics and One Way Analysis of variance for marginal discrepancy of casts fabricated from impressions made using different trays**

Group	N	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean	
					Lower bound	Upper bound
I	10	38.83	1.37	0.434	37.88	39.84
II	10	37.82	1.37	0.434	36.84	38.81
III	10	42.99	1.05	0.334	42.24	43.75
IV	10	39.99	1.92	0.608	38.62	41.37

Source of variance		Sum of Squares	Df	Mean Square	F	Sig.
Impression tray	Between Groups	149.553	3	49.851	23.257	.000
	Within Groups	77.165	36	2.143		
	Total	226.718	39			

\*Level of significance p≤0.05

**Table 2: Summary of Post Hoc Tukey's analysis for pairwise comparison of marginal discrepancy of casts fabricated from impression made using different trays**

Group	N	Subset for alpha = 0.05		
		1	2	3
II	10	37.829000		
I	10	38.864000	38.864000	
IV	10		39.998000	
III	10			42.996000
Sig		0.048	0.323	1.000

\* Means for groups in homogeneous subsets are displayed

**DISCUSSION**

Oral implantology is the science and discipline concerned with the diagnosis, design, insertion, restoration, and/or management of alloplastic or autogenous oral structure to restore the loss of contour, comfort, function, aesthetic, speech, and/or health of the partially or completely edentulous patient<sup>1,2,4</sup> Oral implantology comprises two phase : surgical phase and prosthetic phase.

In the process of making an implant-supported prosthesis, clinical and laboratory procedures contribute to distortion of the implant-supported prostheses.<sup>2,3</sup> Small discrepancies can lead to stresses on the implants when the framework is screwed onto the implants. To provide a passive fit, a framework should induce no strain on the supporting implant components or the surrounding bone in the absence of an applied external load.<sup>8</sup> Imprecise superstructure fit can have both mechanical and biologic consequences that disrupt continuous function.<sup>4,5</sup> Mechanical complications include loosening, bending, and fracture of implants and superstructure components. Biologic complications, though often involving infectious processes, can occur as a result of loads beyond physiologic tolerance levels.<sup>4,5</sup>

Because of the precise fit of implant components and the rigid connection of implant to bone, the accuracy of the master cast is even more critical when compared to conventional fixed prosthodontics.<sup>6</sup> The fit of a prosthesis depends on having an accurate definitive cast, which relies on the accuracy of the dental impression. The precision in fabrication of prosthesis that is proper for the tissues to be restored is dependent on impression material, technique and type of tray.<sup>1-4,6,9,10</sup>

A variety of impression materials are currently available for implant impressions, which includes polyvinylsilaxane, condensation silicone, polyether, polysulphide elastomeric impression materials, hydrocolloids and impression plasters. Two widely used materials are PVS and PE because they showed greater dimensional stability, hardness, elastic recovery.<sup>11-16</sup>

There are two basic impression techniques used for transferring implant positions, namely, direct and indirect impression techniques.<sup>4,5,6</sup> In the direct technique impression copings are picked up with the impression when it is removed from the mouth.<sup>4</sup> However, necessity of unscrewing guide screws retaining the transfer copings before removing the impression can be a disadvantage in clinical practice.<sup>4</sup> In the indirect technique, the impression transfer copings are retained on the implants upon removal of the impression. The procedure is simple, but accurately repositioning the copings into their respective imprints is crucial.<sup>4</sup> Although, the indirect impression technique is clinically preferred, the impression copings are not frequently replaced correctly into the impression. Depending upon data analyses, direct technique is more accurate than indirect technique.<sup>4,5,6,10</sup>

Type of tray is another important factor affecting accuracy of impressions. In the present study there was statistically significant difference between marginal discrepancy of impressions made using custom tray, stock tray, Mira tray and Kohler tray. (Table 1.) Impression made using custom tray showed least marginal discrepancy followed by stock tray, Kohler tray and Mira tray respectively.

The results of the present study indicate that custom tray impression technique was better than stock tray and advance stock trays (Mira tray, Kohler tray). Marginal discrepancy of custom tray impressions was insignificant with stock tray. This result was in consensus with the result of Juliana et al<sup>6</sup> who concluded that the impression made with custom tray was more accurate than the mira tray. Jason et al<sup>10</sup> found that the impression made with custom tray and stock tray showed a statistically significant difference. The custom tray impression show more accurate results than stock tray.<sup>10</sup> The reason for accurate impression of custom tray could be that the custom trays are more stable and allowed a homogenous thickness of the material and consequently more accurate casts.<sup>6,17-19</sup>

Ideally, an impression must be made in the shortest possible time, be easy to perform, have low cost, be comfortable for the patient, and allow accurate casts to be obtained, so the metal stock impression tray was used but it also has certain disadvantages. If the opening is narrow, then it is difficult to position the impression tray while the impression is being made; in contrast, if the opening is wide, then there is excessive overflow of the impression material and the tray is weakened. Further trimming of metal tray is tedious, harmful to the operator and tray once trimmed cannot be used. To overcome this the advanced stock trays were introduced with modifications in conventional stock tray. The "Mira and Kohler implant impression trays" are considered among advanced stock tray, which are introduced as option for making impressions of dental implants in a simpler and faster manner than compared to custom trays.<sup>6,7,20</sup>

The results of the present study indicate that stock tray was better than advanced stock tray. Juliana M et al<sup>6</sup> also concluded that the conventional open tray was statistically more accurate than self-perforating impression tray.<sup>4</sup> The present study also showed that Kohler advanced tray was statistically more accurate than Mira advanced tray. A disadvantage of the Mira tray is that unlike the conventional custom tray, it is not individualized and it is not rigid. Because it has certain flexibility, it may distort in the act of impression making if the tray size is not large enough; it, therefore, could interfere with anatomic structures and caused deformation of the cast.<sup>6,20,21</sup>

Yung K et al and Juliana M et al stated that in implant supported prosthesis marginal discrepancy ranging from 90 to 150µm is clinically acceptable.<sup>6,22</sup> In the present study marginal discrepancy was least for custom tray impression (37.82±1.374 µm), followed by stock tray (38.83±1.374 µm), Kohler tray (39.99±1.924 µm) and Mira tray (42.99±1.056 µm) respectively. All marginal discrepancy values were in the range proposed by Yung K et al and Juliana M et al.<sup>6,22</sup> Though there was statistically significant difference amongst tested techniques, all were in the clinically acceptable range. Thus all the evaluated impression trays proved suitable for making implant impressions with direct technique.

## CONCLUSION

Various implant impression techniques can be used for making implant impressions. The fit of a implant prosthesis depends on having an accurate definitive cast, which relies on the accuracy of the implant impression. In the present study there was statistically significant

difference between all the impression trays. Custom tray showed least marginal discrepancy followed by stock tray, Kohler tray and Mira tray respectively. Though there was statistically significant difference amongst tested techniques, all were in the clinically acceptable range. Thus all the evaluated impression trays proved suitable for making implant impressions with direct technique. The selection of impression trays for implant impressions depends on clinical situation, availability of materials, skill and choice of operator.

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